

Contents

Abstract	11
1 Introduction	13
1.1 Motivation	13
1.2 Contribution	15
1.3 Structure	17
2 Pervasive Computing Concepts	19
2.1 Pervasive Computing	19
2.1.1 Context	20
2.1.2 Roles	23
2.1.3 System-support for Pervasive Computing	26
2.1.4 Devices	28
2.2 Security Goals	30
2.2.1 Confidentiality	30
2.2.2 Integrity	31
2.2.3 Availability	31
2.2.4 Authenticity	32
2.2.5 Privacy	33
2.3 Applications	34
2.3.1 PEDES	34
2.3.2 GAMBAS	36
3 System Support for Security and Privacy in Pervasive Computing	39
3.1 Related Work	39
3.1.1 Type of Pervasive Infrastructure	39
3.1.2 Environment Boundaries	41
3.1.3 Context and Role Privacy and Security	43
3.1.4 Trust	44
3.1.5 Secure Key-exchange	46
3.1.6 Individual Privacy Policy	48
3.2 Requirements for Security and Privacy in Pervasive Computing	50

4 Peer-based Context Management	55
4.1 Privacy-Preserving Context Management	55
4.1.1 Preliminaries	55
4.1.2 Context Model	56
4.1.3 System Architecture	58
4.2 Secure Context Distribution Framework	61
4.2.1 Preliminaries	61
4.2.2 System Model	63
4.2.3 Example Scenario	63
4.2.4 Requirements	64
4.2.5 Context Distribution Framework	65
4.3 Conclusion	71
5 Secure Adaptation with Role Assignment	73
5.1 Preliminaries	73
5.2 Requirements	75
5.3 Approach	76
5.3.1 Generic Role Assignment	77
5.3.2 Adaptive Environment Role Assignment	78
5.3.3 Secure Role Assignment	79
5.3.4 Trust Model	80
5.3.5 Security Rules	81
5.3.6 Security Enforcement	83
5.4 Implementation	85
5.4.1 Architecture	85
5.4.2 Interaction	88
5.4.3 Integration	91
5.5 Applications	94
5.5.1 Traffic Management	95
5.5.2 E-Health	96
5.6 Conclusion	97
6 Secure Key-Exchange	99
6.1 Preliminaries	99
6.2 Approach	101
6.2.1 System Model and Assumptions	101
6.2.2 Design Rationale and Goals	102
6.2.3 Key Exchange Protocol	103
6.3 Implementation	110
6.3.1 Core Library	110
6.3.2 Google Calendar Plug-in	111
6.3.3 Facebook Event Plug-in	112

6.4	Applications	113
6.4.1	Privacy-preserving Speaker Recognition	114
6.4.2	Configuration-free Conference Registration	115
6.4.3	Energy-efficient Resource Sharing	115
6.5	Conclusion	117
7	Automating Policy Generation	119
7.1	Preliminaries	119
7.2	Approach	120
7.2.1	System Model	121
7.2.2	Design Rationale and Goals	122
7.2.3	Privacy Policy Generation Framework	123
7.3	Implementation	126
7.3.1	Context Types and Recognition	126
7.3.2	Privacy Policy Generator Library	127
7.3.3	Google Calendar Plug-in	130
7.3.4	Facebook Status Messages Plug-in	130
7.4	Application	131
7.5	Conclusion	133
8	Evaluation	135
8.1	Privacy-Preserving Context Management	135
8.1.1	Experiments	136
8.1.2	Qualitative Evaluation	139
8.2	Secure Context Distribution Framework	140
8.2.1	Discussion	140
8.2.2	Measurements	141
8.2.3	Qualitative Evaluation	144
8.3	Secure Adaptation with Role Assignment	144
8.3.1	Configurable	145
8.3.2	Composable	146
8.3.3	Flexible	146
8.3.4	Secure	147
8.3.5	Light-weight	148
8.3.6	Experiments	148
8.3.7	Qualitative Evaluation	154
8.4	Secure Key-Exchange	156
8.4.1	Full Automation	156
8.4.2	High Security	156
8.4.3	Low Latency	158
8.4.4	Scalability	161
8.4.5	Qualitative Evaluation	162

Contents

8.5	Automating Policy Generation	164
8.5.1	Generic	164
8.5.2	Extensible	165
8.5.3	Automation	166
8.5.4	Low Overhead	166
8.5.5	Qualitative Evaluation	169
8.6	Conclusion	169
9	Conclusions and Outlook	173
9.1	Outlook	175
	Bibliography	177